

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT



(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference PC0026 | FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA416) | |
| International application No. PCT/B 03/01271 | International filing date (<i>day/month/year</i>) 08.04.2003 | Priority date (<i>day/month/year</i>) 11.04.2002 |
| International Patent Classification (IPC) or both national classification and IPC C03B5/027 | | |
| Applicant TREND GROUP SPA et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

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| Date of submission of the demand 11.11.2003 | Date of completion of this report 23.08.2004 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | Authorized Officer Creux, S Telephone No. +31 70 340-3027  |

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/IB 03/01271**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-3, 6-14 as originally filed
4, 5 received on 28.06.2004 with letter of 28.06.2004

Claims, Numbers

1-15 received on 28.06.2004 with letter of 28.06.2004

Drawings, Sheets

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

see separate sheet

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|---------------|
| Novelty (N) | Yes: Claims | 2-4,6-8,10-15 |
| | No: Claims | 1,5,9 |
| Inventive step (IS) | Yes: Claims | 7,8 |
| | No: Claims | 1-6,9-15 |
| Industrial applicability (IA) | Yes: Claims | 1-15 |
| | No: Claims | - |

2. Citations and explanations

see separate sheet

Re Item I

Basis of the report

1. Some amendments are considered to add subject-matter, contrary to the requirements of Art. 34(2) PCT.

Claim 1 refers to "said electrodes having a substantially constant cross-section over their entire length".

Claims 5 refers to "said electrodes having (...) a substantially constant cross-section over their entire length".

Though not indicated by the applicant, these amendments appear to be based on Fig. 1 to 4. However drawings are only schematic representations, hence it is not possible to derive from Fig. 1-4 that the electrodes have a substantially constant cross-section over their entire length.

Hence the present report (see Item V) is made on the basis of claims 1-15 filed on 28-06-2004 except for the non allowable feature above of claims 1 and 5.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents :

D1: DE-C-564491

D2 : UAS-A-4143232

1. The present report is made on the basis of claims 1-15 filed on 28-06-2004 except for the non allowable feature above of claims 1 and 5 (see Item I for reasons).
2. Document D1 discloses (see. Fig. 1) a method for melting vitrifiable materials, in an electric furnace with floor, sidewalls, a crown and a plurality of electrodes of predetermined shape, all the electrodes resting on the floor over their entire length. The channels for discharging the molten materials are implicit. The method of D1 further comprises introducing batch raw materials into the furnace, which will form a layer onto the surface of the molten bath, hence partly screening the crown from the heat.
Hence the subject-matter of **claim 1** is not new (Article 33(1), (2) PCT).
3. Dependant claims 2 to 4 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Art. 33(1), (3) PCT).

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EXAMINATION REPORT - SEPARATE SHEET**

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- 3.1. The additional features of **claims 2 and 3** are a matter of normal design.
- 3.2. Concerning **claim 4**, the optimization of known parameters in order to achieve a known to be desirable result does not involve an inventive activity.
4. The arguments of § 1. apply mutatis mutandis to the apparatus claim 5. Hence the subject-matter of **claim 5** is not new (Article 33(1), (2) PCT).
The subject-matter of **claim 9** is not new (Article 33(1), (2) PCT) either since the constraints set by the additional features of claim 9 are always met. ...
5. Dependent claims 6, 10-15 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Art. 33(1), (3) PCT).
 - 5.1. Concerning **claim 6**, cylindrical electrodes are one of several straightforward possibilities among which the skilled person would choose.
 - 5.2. The additional features of **claims 10 and 11** are a matter of normal design.
 - 5.3. Discharging molten materials under the level of the floor is well-known in electric furnaces (see eg. D2 , Fig. 1). The additional features of **claims 12-15** do not go beyond the scope of the customary practice of the skilled person.
6. Dependent **claim 7** is considered to meet the requirements of Article 33(1)-(3) PCT. The subject-matter of claim 7 differs from the furnace of D1 in that the electrodes have one end rigidly secured to a side wall and the other end in contact with the opposite side wall so as to be slightly compressed. The effect of this feature is to reduce the wear at the tip of the electrodes. The skilled person, confronted with the problem of reducing the wear of the electrodes in the furnace of D1 could consider several possibilities including eg. changing the material of the electrodes. The area between facing electrodes is the hottest in the furnace of D1 and is essential for melting the raw materials. Hence the skilled person would not think of extending the electrodes of D1 up to the opposite wall.
Claim 8 also appear the meet the requirements of Article 33(1)-(3) PCT.
7. **Claims 1-15** meet the requirements of Article 33(4) PCT as the method and furnace can be used for the manufacture of ceramic frits for building materials.
8. An error is noticed in amended claim 12, which refers to floor (12) instead of floor (4)

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(Rule 11.13(m) PCT).

(102)

A second disadvantage of the solution in question consists in the fact that the ends of the electrodes are freely immersed in the molten bath, resulting in a high intensity of current in the vicinity of the said ends. For this reason, the immersed ends of the electrodes are subject to rapid wear.

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DE-C-564491 discloses an electric furnace with a plurality of electrodes placed on the floor. Each electrode has a variable cross-section and an interruption in correspondence of a central area of the bath. This interruption defines an internal space in which the convection currents of the melting bath originate. The variable cross-section of the electrodes is specifically directed to provide a vertical extension of the melting bath and does not prevent an increase in the overall head, change time and power consumption of the melting process.

US-A-4143232, which is considered the nearest prior art on which is based the preamble of claims 1 and 5, comprises a glass furnace comprising three groups of electrodes which are positioned in the melting tank at three different levels in order to yield convection currents in the molten bath. The groups of electrodes which are placed at the upper level far from the floor play a very important role during the process as they allow to keep the molten bath flatter and more stable. Moreover, the other two groups of electrodes are placed at different levels and distances from the side walls of the tank in order to improve the control of the convection currents and of the shape of the melting bath. This known furnace has no provision for reducing to a minimum the head of the molten bath, the time for changing the primary batch and the power consumption.

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Disclosure of the invention

A main object of the present invention is that of eliminating the drawbacks mentioned above by providing a method and a furnace for the production of vitreous mosaic materials, ceramic frits and similar products as well as for the vitrification of waste, which have the characteristics of low-cost and limited impact on the environment.

A particular object is that of providing a cold-crown furnace which is able to lower the temperature and the quantity of polluting substances contained in the fumes discharged into the atmosphere.

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A further object of the invention is that of providing an electric furnace which allows a reduction in the time required to change the vitrifiable material.

Another particular object is that of providing an electric furnace which is configured so as to limit the specific power consumption.

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These objects, together with others which will appear more clearly below, are achieved by a method for melting vitrifiable materials, in particular for the production of vitreous mosaic materials and ceramic frits as well as for the vitrification of waste, in accordance with claim 1.

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As a result of this method, it will be possible to reduce the time required for changing the primary batch and the power consumption.

According to a further aspect, the invention provides an electric furnace for melting vitrifiable materials, in particular for the production of vitreous mosaic materials and ceramic frits as well as for the vitrification of waste, where the primary material is frequently changed, in accordance with claim 5.

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Preferably, the electrodes are substantially cylindrical and straight and have a length at least equal to the distance between the opposite side walls of the tank and are arranged substantially parallel to each other at a given mutual distance so as to optimize the distribution of the electric current inside the molten bath.

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Owing to this characteristic feature it is possible to obtain a homogeneous distribution of the power within the molten bath.

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09.07.2004

CLAIMS

(102)

1. A method for melting vitrifiable materials (V), in particular for the production of vitreous mosaic materials and ceramic frits as well as for the vitrification of waste, where the primary material must be frequently changed, comprising the following steps:

- providing a melting tank (2) having a floor (4) and side walls (5) made of refractory material for containing a molten bath (3), with a predetermined head (B) and at least one channel (6) for discharging the molten materials;

- introducing a primary batch of vitrifiable materials (V) into said tank (2) via an entry mouth thereof;

- providing, inside said tank (2), a plurality of electrodes (9) having a predetermined shape and length (L), said electrodes (9) having a substantially constant cross-section over their entire length (L) and being so positioned as to melt completely said vitrifiable materials (V) by means of diffused electric currents;

- depositing a covering layer (C) of vitrifiable materials (V) in the solid state onto the upper surface of said molten bath (3) so as to contain the dispersion of heat from the bath (3) and screen the crown (13) of the furnace;

characterized in that said all electrodes (9) are positioned so as to rest at the same level on said floor (4) over their entire length (L) to reduce to a minimum the head (B) of the molten bath (3), with a consequent reduction in the time required to change the primary batch and the power consumption.

2. Method according to Claim 1, characterized in that the volume of the primary batch is limited by containing said head (B) within predetermined values depending on the diameter of the electrodes (9).

3. Method according to Claim 2, characterized in that said head (B) is kept within values which are between twice and six times the average diameter of the electrodes (9), with said average diameter being between 1" and 2".

4. Method according to Claim 3, characterized in that the floor (4) surface

area of the melting tank (2) and the average specific gather of vitrifiable materials (V) are so selected that the power consumption is kept less than or equal to 0.6 kWh for each kilogram of glass produced.

5 5. An electric furnace for implementing the method according to one or more of the preceding claims, comprising:

- a melting tank (2) for containing a molten bath (3) with a floor (4), side walls (5), channels (6) for discharging the molten materials;

- means (7) for introducing into said tank (2) a primary batch of vitrifiable materials (V) and for depositing a covering layer (C) on the molten bath (3) having a predetermined head (B);

- a plurality of electrodes (9) situated inside said tank (2) so as to melt and keep in the molten state said vitrifiable materials (V) by means of diffused electric currents, said electrodes having an overall length (L) and a substantially constant cross-section over said length (L) and a predetermined position;

15 characterized in that said tank (2) further comprises a crown (13) situated above said floor (4), all said electrodes (9) being so positioned inside the tank (2) to substantially rest at the same level on said floor (4) so as to reduce to a minimum the head (B) of the molten bath (3), with a consequent reduction in the time required to change the primary batch and the power consumption.

20 6. Furnace according to Claim 5, characterized in that said electrodes (9) are substantially cylindrical and straight and are arranged substantially parallel to each other.

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7. Furnace according to Claim 6, characterized in that said electrodes (9) have one longitudinal end rigidly secured to a side wall (5) of the tank and the other longitudinal end in contact with the opposite side wall (5) so as to be slightly compressed or tensioned at the tip.

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8. Furnace according to Claim 7, characterized in that the mutual distance between said electrodes (9) is determined so as to optimize the distribution of the

electric current inside the molten bath (3).

9. Furnace according to Claim 5, characterized in that the side wall (5) of said tank (2) has a minimum height (H) which is greater than the maximum value
5 of the head (B) plus the maximum thickness (S) of said covering layer (C).

10. Furnace according to Claim 9, characterized in that said minimum height (H) of the side walls (5) of the tank (2) is between 35 and 60 cm with the diameter of said electrodes between 1" and 2½".

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11. Furnace according to Claim 10, characterized in that said minimum height (H) is preferably between 40 and 60 cm with the diameter of said electrodes (9) between 1" and 2½".

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12. Furnace according to Claim 8, characterized in that said discharge channels (6) extend in said floor (12) at least partially underneath the level of said
electrodes (9) to prevent these latter from hindering the flowing out of the molten bath (3).

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13. Furnace according to Claim 12, characterized in that said discharge channels (6) comprise at least one main receiving canal (10) connected to the outside of the furnace by means of a discharge gully (11).

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14. Furnace according to Claim 13, characterized in that said discharge channels (6) comprise a plurality of secondary receiving canals (12) connected to said main canal (10).

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15. Furnace according to Claims 13 and 14, characterized in that said main and secondary canals (10, 12) are transverse to each other and extend completely underneath said electrodes (9).